



100% DESIGN CONSTRUCTION QUALITY ASSURANCE PLAN

HIMCO DUMP SUPERFUND SITE FINAL LANDFILL CLOSURE ELKHART, INDIANA

Prepared For:



EPA United States
Environmental Protection
Agency

**Region 5
Chicago, Illinois**

Prepared By:



**US Army Corps
of Engineers**
Omaha District

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**CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN
HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA**

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Contractors Daily Report

CQA Inspectors Daily Report

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SECTION I - GENERAL

1. INTRODUCTION

This Construction Quality Assurance Plan (CQAP) has been prepared for the construction of a landfill cover system at the Himco Dump Superfund Site in Elkhart, Indiana. The CQAP is intended to insure that the landfill cover system is constructed in accordance with the contract drawings and specifications.

The Construction Quality Assurance (CQA) Engineer shall be responsible for all Quality Assurance (QA) inspection activities associated with construction of the cover system and related features at the Himco Dump Superfund Site. The CQA Engineer will work closely with the Contracting Officer to review and approve contractor submittals. The CQAP addresses the construction quality assurance of the soils, geosynthetics, and related features. The CQA program and the CQA Engineer shall be totally independent from the Contractor and the Contractor's Quality Control (QC) Program. The CQA Engineer shall submit a resume and synopsis listing relevant experience on similar projects for review and approval by the United States Environmental Protection Agency (USEPA).

The CQAP is divided into the following sections:

Section I:	General
Section II:	General Earthwork
Section III:	Waste Regrading and Random and Foundation Fill
Section IV:	Geosynthetic Clay Liner
Section V:	Geomembrane
Section VI:	Geocomposite
Section VII:	Select Fill and Topsoil
Section VIII:	Turf
Section IX:	Landfill Gas Collection System
Section X:	Electrical/Mechanical
Section XI:	General Site Work
Section XII:	CQA Documentation

2. DEFINITIONS

The following are definitions relevant to the design, construction, CQC, and CQA of the cover system at the Himco Dump Superfund Site.

- **Construction Quality Assurance (CQA):** Construction quality assurance refers to measures taken by the CQA organization to assess if the project is constructed in compliance with the contract drawings and specifications and to determine if the construction quality control program is properly implemented. Construction quality assurance includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance is performed by a party independent from product manufacturers and the Contractor.
- **Construction Quality Assurance Engineer.** The CQA Engineer, who shall be a registered professional engineer in the State of Indiana, is the designated representative of the Independent Quality Assurance Team (IQAT) that is responsible for the proper implementation of the Construction Quality Assurance Plan (CQAP). Furthermore, the CQA Engineer has the responsibility of ensuring (through verification and documentation) that the Contractor's Quality Control Plan (CQCP) is being followed in accordance with the contract drawings and specifications. The CQA Engineer will also provide the Contracting

Officer, Oversight Official and other members of the Independent Quality Assurance Team (IQAT) with all documentation, data, or other information as requested in an expedient manner.

- **Contractor:** See Remedial Action Constructor
- **Contracting Officer.** This is the individual who represents, and reports directly to, the contracting organization for this construction action. The Contracting Officer (CO) is responsible for contract administration including compliance with the requirements of regulatory agencies (e.g., USEPA and IDEM), and assuring the regulatory agencies that the project was constructed as specified in the contract drawings and specifications. The Contracting Officer is also responsible for informing the CQA Engineer and Oversight Official of the scheduling and occurrence of all construction activities.
- **Contractor Quality Control (CQC):** A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the Contractor and/or their designated representatives (e.g., geosynthetics installer, earthwork contractor, etc.) and is necessary to achieve quality in the constructed or installed system. Construction quality control refers to measures taken by the Installer or Contractor to determine compliance with the requirements for materials and workmanship as stated in the contract drawings and specifications. The Contractor shall develop a Contractor Quality Control Plan (CQCP) that contains personnel, procedures, controls, instructions, tests, records, forms, etc. that will be used for quality control purposes.
- **Design Engineer.** The design engineer's primary responsibility is to design a cover system that fulfills the regulatory and operational requirements of the facility and complies with accepted design practices. For the landfill cover system at the Himco Dump Superfund Site, the United States Army Corps of Engineers (USACE) performed the design functions.
- **Earthwork Contractor.** The earthwork contractor is responsible for all waste and soil excavation, placement, and grading aspects of the project. The earthwork contractor is responsible for obtaining suitable earthen materials, placement and compaction of materials, and protection of materials during placement. In addition, the earthwork contractor is responsible for construction quality control operations aimed at controlling materials and placement to ensure that the materials conform with contract drawings and specifications.
- **Independent Quality Assurance Team (IQAT):** The IQAT is formed by representatives from testing and inspection organizations that are responsible quality assurance inspections and testing during construction. The IQAT is independent from the manufacturers and constructor and is retained by the Contracting Organization. The IQAT will have complete access to all construction activities, facilities, and other areas of the project site. A CQA Engineer will be designated by the IQAT to act as the main point-of-contact for the construction quality assurance organization and will be responsible for insuring that the CQAP is properly implemented. Other IQAT personnel, designated Authorized Representatives, are responsible to the CQA Engineer and will assist in CQA testing and inspection as directed by the CQA Engineer.
- **Installer.** Manufactured products (i.e. geosynthetics) are placed and installed in the field by an installation contractor who may be the general contractor, a subcontractor to the general contractor or a specialty contractor. The Installer is responsible for handling, storage, placement, and installation of manufactured and/or fabricated materials. The Installer is also responsible for informing the Contracting Officer of the scheduling and occurrence of all geosynthetic construction activities.

- **Manufacturer.** Many components of the landfill cover system, including all geosynthetics and any piping, are manufactured materials. The Manufacturer is responsible for the production of its products and any quality control during the manufacturing process. The Manufacturer is also responsible for certifying that all of its products delivered to the construction site with the intent of installation meet or exceed the project specifications. The Contracting Officer, permitting agency, CQA Engineer, Oversight Official, Design Engineer, Fabricator, and Installer may request to be allowed to observe the manufacture and quality control procedures of some or all of the raw materials and final product to be used on the construction site.
- **Oversight Official.** The Oversight Official is retained by, and reports directly to, USEPA to provide technical support in all aspects of the remedial action. The Oversight Official is a representative of USEPA but does not have authority to authorize any deviations from contract documents or assume any responsibilities of the Contractor. General responsibilities include reviewing submittals, reports and other project documentation and periodically observing construction activities to monitor the construction quality control/quality assurance programs.
- **Remedial Action Constructor.** The Remedial Action (RA) Constructor, commonly referred to as the Contractor, is the general contractor retained by, and responsible to, the Contracting Organization. The RA Constructor is responsible for all aspects of the project during construction to include developing and implementing the construction quality control program. The RA Constructor has the primary responsibility for ensuring that the facility is constructed in accordance with the contract drawings and specifications. The RA Constructor is also responsible for informing the Contracting Officer and the CQA Engineer of the scheduling and occurrence of all construction activities.
- **Quality Control (QC) Inspector.** The QC Inspector is the Contractor's CQC System Manager of representative that is responsible for implementing the contractor quality control program to insure that the project is constructed in accordance with the contract drawings and specifications.
- **QA Laboratory/Independent Laboratory.** The QA Laboratory/Independent Laboratory shall have the qualifications required by the specifications and shall perform QA conformance tests required by the CQAP and the specifications. For geosynthetic testing, the laboratory shall be accredited by the Geosynthetic Accreditation Institute for each required test. The laboratory shall have its own internal QC plan to ensure that laboratory procedures conform to the appropriate American Society for Testing Materials (ASTM) standards or other applicable testing standards. Appropriate sample chain-of-custody records shall be kept. The laboratory must be willing to allow the Contracting Officer, permitting agency, Design Engineer, Installer, or CQA Engineer to observe sample preparation and testing procedures, or record-keeping procedures, if requested.
- **QC Laboratory.** The QC Laboratory shall perform laboratory quality control tests as required by the specifications. For geosynthetic testing, the laboratory shall be accredited by the Geosynthetic Accreditation Institute for each required test. The laboratory shall have its own internal QC plan to ensure that laboratory procedures conform to the appropriate American Society for Testing Materials (ASTM) standards or other applicable testing standards. Appropriate sample chain-of-custody records shall be kept. The laboratory must be willing to allow the Contracting Officer, permitting agency, Design Engineer, Installer, or CQA Engineer to observe sample preparation and testing procedures, or record-keeping procedures, if requested.

3. RESPONSIBILITY AND AUTHORITY

The responsibilities of the parties directly involved with the CQA are discussed below. The duties of the CQC personnel are totally separate from the duties of the CQA personnel and are included in the Construction Contract requirements. The CQA Engineer, CQA Inspection personnel, and QA laboratories shall perform the specific responsibilities of the CQA Engineer which shall include:

- Attending the pre-construction meeting, QC meetings, Contractor coordination meetings, and safety meetings;
- Reviewing design criteria, plans, and specifications for clarity and completeness so that the CQAP can be implemented;
- Educating CQA inspection personnel (if necessary) on CQA requirements and procedures;
- Directing and supporting the CQA inspection personnel in performing observations and tests by:
 - confirming that regular calibration of testing equipment is properly conducted and recorded;
 - verifying that changes to testing equipment, personnel, and procedures do not adversely impact the inspection process;
 - confirming that the test data are accurately recorded, maintained, and interpreted;
 - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted.
- Verifying that the Contractor's CQCP is in accordance with the specifications and that CQC is being performed in accordance with contract requirements and that CQC personnel are completing and documenting properly all on-site observations and tests required. CQA personnel shall review the results of on-site observations and testing completed by the CQC personnel and notify the Contracting Officer of any problems;
- Reporting results of observations and tests as the work progresses and interacting with the Contractor to provide assistance in modifying materials and work to comply with the design and specifications;
- Preparing Construction Quality Assurance Documentation required by the CQAP including Daily Reports, Daily Temperature Logs, Personnel Daily Logs, Contractor Personnel Logs, Weekly Field Reports, Soils CQA Records, Geosynthetics CQA Records, Survey Records, Certifications, Photographic Documentation, Design and Specification Changes, and Final Reports;
- Performing independent on-site CQA inspection of the work in progress to verify conformance with the design criteria, plans, and specifications and shall identify changes in the project conditions which may impact design assumptions. The CQA Engineer shall notify the Contracting Officer of any design and construction problems;
- Verifying that the equipment used in testing meets the specified requirements and that the tests are conducted according to the standardized procedures defined by the specifications;
- Reporting to the Contracting Officer the results of all inspections including work that is not of acceptable quality or that fails to meet the specified design. The CQA shall notify the Contracting

Officer if a work stoppage and possible remedial actions are necessary in the event of non-conformance with the specifications and CQA Plan; and

- Collecting QA conformance samples and performing QA tests as required by the CQA plan.

4. REFERENCES

References utilized to produce this CQAP are cited as follows:

"Quality Assurance and Quality Control for Waste Containment Facilities", Technical Guidance Document EPA/600/R-93/182, United States Environmental Protection Agency, September 1993.

SECTION II

GENERAL EARTHWORK CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the earthwork and grading of the overlot areas outside the limits of the landfill cover system and roads and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental QA conformance testing and visual inspections, and measurements for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification sections 02210: Grading, 02221A: Earthwork For Buildings, and 02222: Excavation, Trenching, and Backfilling for Utility Systems are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer shall be on site at all times while earthwork and grading are being performed. All CQA individuals assigned responsibilities for earthwork and grading shall be familiar with standard earthwork construction practices and shall also be familiar with the test methods required in the project specifications.

2. EARTHWORK/GRADING

2.1. Equipment

All equipment proposed for use during earthwork and grading shall be inspected by the CQA Engineer to ensure compliance with the project specifications.

- Verify that placement and compaction equipment meet specified requirements;

2.2. Submittals

A CQA Engineer shall review each submittal to ensure it complies with the specified requirements. Submittals requiring review include the following:

- As-Built Surveys (Final topographic survey including landfill cover system);
- Qualifications of the QA Laboratory that will be performing QC testing is in accordance with the specifications; and
- Test reports and analysis certifying that suitable materials proposed for use conform to the specified requirements.

2.3. Quality Assurance Conformance Testing Requirements

The following table lists the QA tests which shall be performed on general earthwork during construction.

Test Type	Test Method	Frequency of Testing	Comments
Moisture Content (see Note 1 below)	ASTM D 2216/ASTM D 3017	1 per 6,000 sq. yds. per lift	In-place soils
Density (see Note 2 below)	ASTM D 1556/ASTM D 2922	1 per 6,000 sq. yds. per lift	In-place soils

Note 1 - Water Content tests (ASTM D 2216) to be used once every 10 (ASTM D 3017) rapid tests.

Note 2 - Total Density tests (ASTM D 1556) to be used once every 20 (ASTM D 2922) rapid density tests.

The CQA Engineer shall verify that the above QA conformance tests are in compliance with the requirements of the specification sections.

3. PRODUCTS

Inspect earthwork and grading during construction for the following:

- Check QC test results for soils against the requirements listed in the specifications; and
- Ensure that soils from each borrow source meet the project specifications.

4. EXECUTION

4.1. Excavation

- By visual inspection, verify that topsoil in areas outside of the limits of the existing waste is removed and stored separate from other excavated materials;
- Using survey data and by visual inspection, verify that excavations conform to the requirements of the contract documents;
- By visual inspection, verify that unsuitable material encountered within the limits of the work is removed below the grade indicated and replaced with suitable material as specified;
- Ensure that excavated material not required or not suitable for backfill is wasted over the project site at the discretion of the Contracting Officer;
- With the exception of excavations in the underwater borrow areas, verify that grading is done as necessary to prevent surface water from flowing into excavations, and that any water accumulating therein is removed;
- Ensure that trench bottoms are over excavated to allow the installation of suitable bedding and that trench bottoms are accurately graded to provide uniform bearing;
- Ensure that stockpiles are kept in a neat and well drained condition;

- Ensure that the ground surface at stockpile locations is cleared and grubbed prior to stockpiling as approved by the Contracting Officer. Excavated suitable and unsuitable materials shall be separately stockpiled;
- Verify that stockpiles of suitable materials are protected from contamination; and
- Ensure that the Contractor disposes of all water generated during dewatering activities in accordance with the specifications and that all pipe or conduits approved by the Contracting Officer to remain on-site are left clean and free of sediment.

4.2. Backfill

- Verify that sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed is plowed, stepped, or broken up, as directed, in such manner that the fill material will bond with the existing surface;
- Ensure that all subgrades are scarified and compacted as specified;
- Verify that backfill consists of suitable material and is placed at the specified lift thickness;
- Ensure that material is not placed on surfaces that are muddy, frozen, or contain frost;
- Verify that backfill adjacent to structures is placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures;
- By reviewing QC and QA testing, verify that the moisture content of cohesive soils is within the acceptable range;
- By visual inspection, verify that trenches are backfilled to the grade indicated on the drawings and that pressure tests are performed as required.
- Ensure that loose lifts are placed at the specified thicknesses, compacted with approved methods, and compacted to within the specified moisture content and density ranges;
- By visual inspection, verify thorough compaction of fill under the haunches of pipe;
- Verify that concrete structures are allowed to cure for 5 days prior to backfill placement;
- Ensure that no excavated material is wasted without the authorization of the Contracting Officer and that material authorized to be wasted is disposed of as specified or directed; and
- Verify by visual inspection that backfill is brought to indicated finish grade as shown on the drawings.

4.3. Compaction

- By visual inspection and by reviewing QC and QA test reports, verify that compaction is accomplished by the means and to the density specified;
- By reviewing QC and QA test reports, ensure that each layer of fill is compacted to the specified density and that cohesive soils are at the specified moisture content;

- Verify by visual inspection that cohesionless soils are compacted at a moisture content required to facilitate compaction without bulking; and
- Verify by visual inspection that pavement subgrade is shaped to line, grade and cross section as shown on the drawings.

4.4. Finished Excavation, Fills, and Embankments

- Verify by visual inspection that all excavations and fill areas are uniformly smooth graded and free from irregular surface changes; and
- Review as-built surveys to verify that finished surfaces are constructed to the lines and grades shown on the contract drawings.

4.5. Protection

- Verify that newly graded areas are protected from traffic, erosion, and other damage.
- Verify that damaged areas are repaired and grades are reestablished.

4.5.1. Protection of Existing Service Lines and Utilities Structures

- Ensure that existing monitoring wells, structures, and utilities are protected from damage. Verify that any damage to these items is repaired by the Contractor.

4.6. Adjustment of Existing Structures

- By visual inspection, verify that manholes, valve boxes, structures that do not conform to the new finish grade in either surfaced or un-surfaced areas are adjusted to the new finish grade.

SECTION III

WASTE REGRADING AND RANDOM AND FOUNDATION FILL CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for waste regrading and random and foundation fill components of the cover system and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental QA conformance testing and visual inspections, and measurements for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02211: Excavation, Initial Grading, and Random and Foundation Fill for Landfill are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer shall be on site at all times during construction. All CQA individuals assigned responsibilities for the waste regrading and random and foundation fill activities shall be familiar with earthwork construction and shall also be familiar with the test methods required in the project specifications.

1.2. Submittals

A CQA Engineer shall review each submittal to ensure it complies with the specified requirements. Submittals requiring review include the following:

- Borrow source classification test results;
- Borrow source chemical quality test results;
- Landfill Excavation and Regrading Plan; and
- Inspection Trench Logs.

2. WASTE REGRADING

2.1. Equipment

All equipment proposed for use during excavation and compaction of existing landfill material shall be inspected by the CQA Engineer to ensure compliance with the project specifications and the Landfill Excavation and Regrading Plan.

- Verify that the placement and compaction equipment are suitable for their intended purpose and will result in a well compacted foundation for the cover system.

2.2. Quality Assurance Conformance Testing Requirements

No quality assurance testing is required.

2.3. Execution

- A CQA Engineer shall be present at all times during excavation and regrading activities including the excavation of the perimeter inspection trench.
- Verify all waste located outside of the inspection trench is relocated to within the limits of the final cover system as required in the specifications.
- Verify that relocated waste is placed at the thickness specified.
- Verify that compaction equipment make the specified number of passes on each lift of waste.
- Verify that cleared and grubbed material is chipped or cut prior to placement and that it is thoroughly mixed with soils, spread uniformly throughout the landfill, and compacted with the specified number of passes.
- Verify that stormwater is controlled to prevent release of contaminants.

3. RANDOM FILL LAYERS

3.1. Equipment

All equipment proposed for use for placement and compaction of random fill material shall be inspected by the CQA Engineer to ensure compliance with the project specifications and the Landfill Excavation and Regrading Plan.

- Verify that the placement and compaction equipment are suitable for their intended purpose and will result in a well compacted foundation for the cover system.

3.2. Quality Assurance Conformance Testing Requirements

The CQA Engineer shall be responsible performing field tests. The location and purpose of the tests shall be noted in the daily log. The following table lists the CQA tests which shall be performed on the random fill layers during construction.

Test Type	Test Method	Frequency of Testing	Comments
Moisture Content (see Note 1 below)	ASTM D 2216/ASTM D 3017	1 per 12,000 sq. yds	In-place soils
Density (see Note 2 below)	ASTM D 1556/ASTM D 2922	1 per 12,000 sq. yds	In-place soils

Note 1 - Water Content tests (ASTM D 2216) to be used once every 10 (ASTM D 3017) rapid tests.

Note 2 - Total Density tests (ASTM D 1556) to be used once every 20 (ASTM D 2922) rapid density tests.

The CQA Engineer shall verify that the above QA conformance tests are in compliance with the requirements of the specification.

3.3. Execution

- A CQA Engineer shall be present at all times during placement and compaction of random fill.

Inspect the soil during and placement and compaction for the following:

- Verify that compaction equipment make the specified number of passes on the first lift of random fill. The first lift of random fill has no specific density requirements.
- Check the QC test results for subsequent layers of random fill against the requirements listed in the specifications.
- Verify that loose lifts thicknesses are within the range specified.

4. FOUNDATION LAYER

4.1. Equipment

All equipment proposed for use for placement and compaction of foundation material shall be inspected by the CQA Engineer to ensure compliance with the project specifications and the Landfill Excavation and Regrading Plan.

- Verify that the placement and compaction equipment are suitable for their intended purpose and will result in a well compacted foundation for the cover system.

4.2. Quality Assurance Conformance Testing Requirements

The CQA Engineer shall be responsible for collecting QA soil samples and sending them to the QA laboratory for testing. Each sample shall be numbered and dated. The location and purpose of the samples and tests shall be noted in the daily log. The following table lists the CQA tests which shall be performed on the random fill layers during construction.

Test Type	Test Method	Frequency of Testing	Comments
Grain Size	ASTM D 422	1 per 36,000 sq. yds	In-place soils
Moisture Content (see Note 1 below)	ASTM D 2216/ASTM D 3017	1 per 12,000 sq. yds	In-place soils
Density (see Note 2 below)	ASTM D 1556/ASTM D 2922	1 per 12,000 sq. yds	In-place soils

Note 1 - Water Content tests (ASTM D 2216) to be used once every 10 (ASTM D 3017) rapid tests.

Note 2 - Total Density tests (ASTM D 1556) to be used once every 20 (ASTM D 2922) rapid density tests.

The CQA Engineer shall verify that the above QA conformance tests are in compliance with the requirements of the specification.

4.3. Execution

- A CQA Engineer shall be present at all times during placement and compaction of foundation layer fill.

Inspect the soil during and placement and compaction for the following:

- Check the QC test results for the soils against the requirements listed in the specifications.
- Verify that loose lifts thicknesses are within the range specified.
- Verify that the finished foundation layer surface is suitable for installation of the overlying geosynthetics.

SECTION IV

GEOSYNTHETIC CLAY LINER (GCL) CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of the GCL and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02442: Geosynthetic Clay Liner (GCL) are reflected in this section of the CQA plan.

1.1. CQA Personnel.

A minimum of 1 CQA Engineer or Authorized Representative shall be on site at all times during construction of the GCL. All CQA individuals representing the CQA Engineer and assigned responsibilities for the QA for the work required by this section shall be familiar with the construction of geosynthetic clay liners and shall also be familiar with the test methods required in the project specifications.

2. GEOSYNTHETIC CLAY LINER

The CQA Engineer shall verify that the GCL was sampled and tested in accordance with the manufacturer's approved quality control manual and that test results not meeting the requirements specified in the specifications result in the rejection of applicable rolls.

2.1. Submittals.

The CQA Engineer will review each submittal to ensure it complies with the specified requirements. Submittals requiring review:

- A copy of the quality control certificates for the raw materials and rolls, issued by the Manufacturer(s) of the raw materials and rolls, stating that the materials meet the project specifications;
- Manufacturer's QC manual;
- Installer's QC manual;
- Manufacturer's, Installer's, QC Inspector's, and QC laboratory's qualification statements including resume's of key personnel involved in this project;
- QC Laboratory test results including description of equipment and test methods;
- Penetration Details; and
- Direct Shear Test Results.

The CQA Engineer shall review the above information and verify that:

- The above qualification statements, manuals, and details are in compliance with the contract documents;
- The property values certified by the GCL Manufacturer meet all of the specified values;
- The measurements of properties by the GCL Manufacturer are properly documented and the test methods used are in accordance with the GCL Specification; and
- The QC certificates have been provided at the specified frequency for the GCL rolls, and each certificate identifies the rolls or batch number related to that certificate.

2.2. Labeling

The CQA Engineer shall examine the GCL rolls upon delivery and shall verify that the GCL manufacturer has labeled all rolls of GCL with the Manufacturer's name, product identification, lot number, roll number, roll dimensions, roll weight, and date manufactured. The CQA Engineer shall record the roll number and date each roll was delivered.

2.3. Delivery, Unloading, and Storage

Upon delivery of the GCL, the CQA Engineer, GCL Installer, and the QC Inspector shall verify the following:

- GCL is shipped, unloaded, and stored, ensuring that no damage to the GCL occurs;
- GCL is kept free of moisture, dirt, or any other foreign material;
- Rolls of GCL are packaged in an opaque, waterproof, protective covering wrapped around a central core which is structurally capable of supporting the weight of the roll without excessive bending under normal handling conditions;
- Rolls of GCL are continuously supported during storage and kept in their original, unopened, protective covering;
- Rolls of GCL are stacked no more than two rolls high;
- Storage, placement, and stacking of rolls of GCL is performed to avoid thinning of the product at points of contact; and
- Field storage of GCL is in flat dry areas where water cannot accumulate or the rolls are elevated off the ground.

The CQA Engineer will inventory the delivered GCL and shall report to the Contracting Officer any rolls or portions thereof that should be rejected and removed from the site, and of any roll with minor flaws that are repairable.

2.4. Quality Assurance Conformance Testing

Upon delivery of the GCL rolls, the CQA Engineer shall collect Quality Assurance conformance samples at a rate of one per 100,000 SF. One out of every 4 samples shall be randomly selected by the CQA Engineer and

forwarded to the QA Laboratory for testing to verify conformance with requirements of the GCL Specification. The remaining samples will be retained for possible additional testing.

QA Conformance samples shall be taken across the entire width of the roll and will not include the outer wrap of the roll. Samples shall be 3 feet (minimum) long by the roll width with the machine direction marked on the sample by the CQA Engineer. The CQA Engineer shall write on the sample and affix a label to the sample with the following information:

- Lot/batch number;
- Roll number;
- Date sampled;
- Project name;
- Manufacturer; and
- CQA Engineer's name.

The Quality Assurance conformance samples shall be tested for the following:

- Bentonite Mass/Unit Area (ASTM D 5993);
- Flux, maximum (ASTM D 5887);
- Puncture Resistance, minimum (ASTM D 4833)
- Swell Index Test, minimum (ASTM D 5890);
- Fluid Loss, maximum (ASTM D 5891); and
- Wide Width Tensile, machine direction minimum (ASTM D 4595).

The CQA Engineer shall examine all results of QA Laboratory conformance testing and verify that the test results are in compliance with the GCL Specifications and report any nonconformance to the Contracting Officer.

3. GCL INSTALLATION

The CQA Engineer shall visually inspect and verify that the Installer handles all GCL in such a manner as to ensure the GCL is not damaged in any way. The CQA Engineer shall periodically observe the installation and verify compliance with the procedures for handling and placement, seams overlap, and repairs.

3.1. Handling and Placement

The GCL Installer is required to handle all GCL in such a manner as to ensure the GCL is not damaged in any way. The CQA Engineer shall be present during the handling, placement and covering of GCL and shall verify compliance with the following:

- Just prior to GCL placement, the subgrade is smooth and free of ruts and erosion rills greater than 1 inch in depth, or protrusions greater than 0.5 inches in depth or height, or as recommended by the manufacturer;
- The subgrade is compacted in accordance with the Foundation Layer specification;
- Ensure that no equipment or tools will be used which could damage the GCL by handling, trafficking, or by other means;
- Ensure that GCL is not deployed during precipitation, in the presence of excessive moisture (e.g. fog, dew, frost, rain, snow, hail), in areas of ponded water, or in the presence of excessive winds.
- Each day during placement of the GCL, the CQA Engineer, the QC Inspector and the GCL Installer shall inspect the surface on which GCL is to be placed and certify in writing that the surface is acceptable;
- Verify that the GCL is installed as soon as practical after completion and approval of the subgrade;
- Ensure that GCL panels are not deployed over frozen ground;
- GCL, which has been hydrated prior to being covered by the overlying geomembrane, is removed and replaced. Hydrated GCL is defined as material which has become soft as determined by squeezing the material with finger pressure or material which has exhibited swelling;
- No construction equipment is allowed directly on the GCL during installation. A minimum of 12 inches of soil is placed before low ground pressure construction equipment can operate on top of GCL;
- The Contractor is taking all necessary precautions to prevent damage to the subgrade during placement of the GCL;
- On side slopes, the GCL is anchored at the top and rolled down the slope to continually keep the GCL panel in tension and prevent loss of bentonite;
- In the presence of wind, all GCL is weighted with sandbags or equivalent;
- Visually examine the GCL over the entire surface after installation, to ensure that damaged areas, if any, are identified and repaired;
- GCL cut using scissors, hooked blade, or other cutting tools approved by the CQA Engineer will not damage the underlying geosynthetics; and
- GCL is not being dragged over the subgrade and GCL edges are pulled tight to maximize contact and smooth out wrinkles.

3.2. Seams and Overlaps

The CQA Engineer shall visually inspect the seams and overlaps and verify the following:

- All GCL seams are oriented parallel to the line of maximum slope and the panels are free of tension or stress upon completion of installation. Panels should be positioned with the overlap

recommended by the GCL Manufacturer. Dirt or other foreign matter is removed from the overlap area immediately prior to seaming;

- Visually inspect and verify that granular bentonite of the same type as the bentonite used for the GCL is placed along the entire overlap width at a minimum rate of 0.25 lbs. per linear foot or as recommended by the GCL Manufacturer;
- Review manufacturers and installers literature and verify that construction adhesives or other approved seaming methods recommended by the Manufacturer are used for horizontal seaming on slopes;
- Visually inspect and verify that overlaps which occur on slopes are constructed with the up slope GCL shingled over the down slope GCL.

3.3. Protection

The CQA Engineer shall visually inspect and verify that only those GCL panels which can be anchored and covered, as specified, before the end of the day are unpackaged and installed. If exposed GCL cannot be covered before the end of the day, verify it is covered with plastic or other waterproof material and ballasted until construction can resume.

3.4. Repairs

The CQA Engineer shall visually inspect and verify that repairs are performed in accordance with the requirements of the GCL Specifications.

3.5. Penetrations

The CQA Engineer shall visually inspect and verify that penetration details are as recommended by the GCL Manufacturer. Ensure that as a minimum, pipe penetrations will incorporate a collar wrapped around the pipe and securely fastened. Dry bentonite or bentonite paste should be placed around the penetration for additional protection.

3.6. Covering

The CQA Engineer shall visually inspect and verify that all GCL deficiencies are repaired prior to covering and that overlying material is not deployed such that tensile stress is mobilized in or damage occurs to the GCL.

SECTION V

GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of geomembrane and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02271: Geomembrane are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer or Authorized Representative shall be on site at all times during construction of the Geomembrane. All CQA individuals representing the CQA Engineer and assigned responsibilities for the QA for the work required by this section shall be familiar with the construction of geosynthetics and shall also be familiar with the test methods required in the project specifications.

2. GEOMEMBRANE MANUFACTURE AND DELIVERY

2.1. Resin Certifications

Prior to the installation of the geomembrane material, the CQA Engineer shall review the following:

- A copy of the quality control certificates issued by the resin Supplier that includes:
 - The origin (resin Suppliers name and resin production plant);
 - Identification (brand name and number);
 - The production date of the resin used in the manufacture of the geomembrane shipped to the site; and
 - The results of tests conducted to verify that the resin is made of virgin uncontaminated ingredients and that the quality of the resin used to manufacture the geomembrane rolls assigned to the project meets the Geomembrane Specification.

2.2. Resin Quality Control Test Result Verifications

The CQA Engineer shall obtain the resin source lot numbers from the manufacturer and compare them with the manufacturer's roll listing to verify the proposed resin was used to manufacture the rolls delivered to the site.

2.3 Roll Quality Control Test Result Verifications

The CQA Engineer shall obtain the roll numbers from the Manufacturer and compare them with the Manufacturer's quality control certificates of laboratory test results to verify that the proposed geomembrane rolls to be delivered to the site meet the project specifications.

Prior to installation of the geomembrane materials, the CQA Engineer shall review a copy of the quality control certificates issued by the geomembrane Manufacturer that includes the following:

- Laboratory test results showing that the geomembrane meets the project specifications; and
- Statement certifying that no post consumer (reclaimed) materials are added to the resin.

2.4 Submittals

Prior to the installation of the geomembrane, the CQA Engineer shall review the following:

- Manufacturer's certifications and quality control test results for resin, geomembrane rolls, and welding beads and/or rod;
- Geomembrane panel layout and penetration detail drawings;
- Manufacturer's QC manual;
- Installer's QC manual;
- Manufacturer's, Installer's, QC Inspector's, and QC laboratory's qualification statements including resumes of key personnel involved in the project; and
- Direct Shear Test Results.

The CQA Engineer shall review the above information and verify that:

- The above qualification statements, manuals, and details are in compliance with the contract documents;
- The property values certified by the geomembrane Manufacturer meet all of the specified values;
- The measurements of properties by the geomembrane Manufacturer are properly documented and the test methods used are in accordance with the Geomembrane Specifications; and
- The QC certificates have been provided at the specified frequency for the geomembrane rolls, and each certificate identifies the rolls or batch number related to that certificate.

2.5 Labeling

The CQA Engineer shall examine the geomembrane rolls upon delivery and verify that the geomembrane Manufacturer has labeled each roll of geomembrane with manufacturer's name, product type, roll numbers and manufacture dates as specified.

2.6 Delivery, Handling and Storage

Upon delivery of the geomembrane, the CQA Engineer, Geomembrane Installer, and the QC Inspector shall verify the following:

- The geomembrane is handled and stored in accordance with the Geomembrane Specifications and is protected from puncture, abrasion, excessive heat or cold, material degradation, adhesion of individual layers or other damaging circumstances;
- Geomembrane rolls are not stacked more than two rolls high;
- Temporary storage at the project site is away from standing water and performed without crushing the core of roll goods or flattening of the rolls; and
- Damaged geomembrane has been removed from the site.

The CQA Engineer will inventory the delivered geomembrane and shall report to the Work Order Manager about any rolls or portions thereof that should be rejected and removed from the site, and of any roll with minor flaws that are repairable.

2.7 Quality Assurance Conformance Testing.

Upon delivery of the rolls of geomembrane, the CQA Engineer shall collect samples at the rate of one per lot or one per every 100,000 SF of geomembrane to be placed. One out of every four samples shall be randomly selected by the CQA Engineer and forwarded to the QA Laboratory for testing to verify conformance with the Geomembrane Specifications. The other samples shall be retained for possible additional testing.

QA Conformance samples shall be taken across the entire width of the roll and will not include the outer wrap of the geomembrane roll. Samples will be 1.5 feet (minimum) long by the roll width with the machine direction marked on the sample by the CQA Engineer. The CQA Engineer shall also write on the sample and affix a label to the sample with the following information:

- Sample number;
- Date sampled;
- Project name; and
- Manufacturer.

The QA conformance samples shall be tested for the following:

- Thickness (ASTM D 5199);
- Elongation at yield and break (ASTM D 638, Type IV);
- Tensile Strength at yield and break (ASTM D 638, Type IV);
- Tear Resistance (ASTM D 1004, Die C); and
- Puncture Resistance (ASTM D 4833).

The CQA Engineer shall examine all QA Laboratory conformance testing and verify that the test results are in compliance with the Geomembrane Specifications and shall report any nonconformance to the Contracting Officer.

3. GEOMEMBRANE INSTALLATION

The CQA Engineer shall visually inspect and verify that the following procedures are performed by the Contractor and Installer.

3.1. Surface Preparation

The CQA Engineer and Geomembrane Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable and shall ensure that the surface is prepared as specified for Geomembrane placement. The CQA Engineer shall visually inspect on a daily basis and verify that the subgrade does not contain any other debris which could damage the geomembrane. Verify those materials are removed from the surfaces to be covered with the geomembrane. The CQA Engineer shall ensure that any significant subgrade damage is repaired by the Contractor.

3.2. Geomembrane Deployment

3.2.1. Field Panel Placement

The CQA Engineer shall visually inspect and verify that field panels are installed at the locations and positions indicated in the Installers Layout Drawings, as approved by the Contracting Officer and CQA Engineer. The CQA Engineer shall record the identification code, location, and date of installation of each field panel.

3.2.2. Geomembrane Placement

During geomembrane placement, the CQA Engineer shall conduct a thorough inspection and verify the following:

- Any rolls, or portions thereof, containing severe flaws, are noted, rejected, and removed from the site;
- Any rolls which include minor repairable flaws are repaired;
- Geomembrane is placed with a minimum of handling and that the procedures used do not damage the geomembrane or underlying subgrade;
- Geomembrane damaged during installation is removed or repaired in accordance with the Geomembrane Specifications;
- Only geomembrane that can be anchored and seamed together the same day will be deployed;
- The Installer places adequate ballast (e.g., sand bags) on the geomembrane to prevent uplift by wind without damaging the geomembrane;
- Only small rubber tired equipment, with maximum tire inflation pressures of 5 lb per square inch is allowed directly on the geomembrane;
- The geomembrane panels are placed from an upslope to downslope direction;

- The method used to deploy the geomembrane does not scratch, stretch, or crimp the geomembrane; and
- Seams are oriented parallel to the line of maximum slope. Where seams can only be oriented across the slope, the upper panel/sheet should be lapped over the lower panel/sheet.

3.2.3. Geomembrane Waves

The CQA Engineer shall visually inspect and verify that the method used to deploy the geomembrane minimizes waves and that the geomembrane Manufacturer and Installer coordinate efforts to provide sufficient slack in the deployed geomembrane for the coldest temperature anticipated to prevent tensile stresses in the geomembrane and its seams during installation and after the geomembrane is covered. The geomembrane should have adequate slack to prevent uplift from the subgrade or substrate material at any location due to geomembrane tautness. The CQA Engineer shall verify that the Installer prevents geomembrane waves from folding over during placement of overlying geosynthetic material. The height to width ratio of geomembrane waves shall not exceed 0.5. Regardless of the height to width ratio, geomembrane waves shall not exceed 6 inches in height. The CQA Engineer shall verify that the Installer cuts out and reseams any waves which are not acceptable in accordance with the specifications.

3.2.4. Thickness Measurement

For non-textured geomembrane, the CQA Engineer shall take a minimum of five thickness readings along the edge across each panel/sheet width and at least two thickness measurements along each panel/sheet length in accordance with ASTM D 374. For textured geomembrane, ASTM D 5994 will be used to take the same number of thickness readings specified for the non-textured geomembrane. The CQA Engineer shall verify that panels/sheets whose thickness falls below the specified minimum are rejected and replaced. All thickness recordings and actions taken due to inadequate geomembrane thicknesses should be included in the Quality Assurance daily report.

3.2.5. Weather Condition

The CQA Engineer shall visually inspect and verify that the underlying layer has not been damaged by weather conditions and that the geomembrane will only be deployed and field seamed when the geomembrane is dry and winds are low such that the geomembrane is not uplifted and damaged. The CQA Engineer shall verify that seaming is not performed at ambient temperatures below 32 degrees Fahrenheit or above 104 degrees Fahrenheit. In the event of marginal conditions, the Installer should stop all deployment and seaming activities. If the Installer wishes to continue seaming, tests must be run to prove that satisfactory seam strengths are being maintained. Test results must be approved by the Contracting Officer.

3.2.6. Damage

The CQA Engineer shall visually observe each panel after placement and prior to seaming and inspect for damage (e.g., holes, blisters, creases) and mark the location of damage on the panels. The CQA Engineer shall document, in the daily report, the location of the damaged panels or portions of damaged panels, repairs which have been performed, and panels which have been rejected.

3.3. Field Seaming

3.3.1. Seam Layout

The CQA Engineer shall verify that seam layout shown on the Layout Drawings is consistent with the Geomembrane Specifications. In addition, seams not specifically shown on the Layout Drawings may not be made without the CQA Engineer's prior approval.

The CQA Engineer shall verify that a seam numbering system compatible with the panel numbering system agreed upon by the Installer and the Contracting Officer is being used by the Installer.

3.3.2. Seaming Equipment and Product

The CQA Engineer shall verify the following by visually inspecting and by reviewing submittal and contract requirements:

- Equipment used is in accordance with the geomembrane manufacturer's recommendations and is maintained in satisfactory working condition;
- Polyethylene geomembranes have been seamed by thermal fusion methods;
- Extrusion welding is used only for patching and seaming around appurtenances and destructive seam sample locations;
- Only seaming apparatus which the Contracting Officer has specifically approved by make and model is used; and
- The extrusion-seaming apparatus is equipped with gauges, indicating the temperatures of the extrudate and nozzle. The QC Inspector is logging ambient surface temperatures, using a pyrometer, seaming apparatus temperatures and fusion-seaming apparatus speeds. Ambient temperatures will be measured as specified.

The CQA Engineer shall verify that only approved equipment and personnel perform welding, all welding is performed under suitable conditions as specified in the project specifications, specified overlaps are achieved, seams are oriented in accordance to project requirements, and that grinding techniques and extrude meet project requirements for extrusion welding. The CQA Engineer will record the seam number, location, of seam, name of seamer, temperatures of the extrudate and nozzle, ambient surface temperatures using a pyrometer, and fusion-seaming apparatus speeds.

3.3.3. Seam Preparation

The CQA Engineer shall visually inspect and verify that:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material;
- Preparation of seams is in accordance with the Geomembrane Specifications; and

- If seam overlap grinding is required, the grinding marks are to be oriented perpendicular to the seam direction and no marks should extend beyond the extrudate after placement. The depth of the grinding marks should be no greater than 10 percent of the sheet thickness. Extrusion welding should begin within 10 minutes after grinding. Where extrusion fillet welds are temporarily terminated long enough to cool, they shall be ground prior to applying new extrudate over the existing seams.

3.3.4. Weather Conditions for Seaming

The CQA Engineer shall verify weather conditions are within the limits specified in the Geomembrane Specifications.

3.3.5. Trial Seam

The CQA Engineer shall verify that the Geomembrane Installer, in accordance with the Geomembrane Specifications, makes trial seams on test strips of excess geomembrane under field conditions to verify that seaming conditions are adequate.

The CQA Engineer shall observe all trial seam procedures and verify that the QC Inspector assigns a number to and marks the trial seam accordingly and that the QC Inspector logs the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The CQA Engineer shall include the trial seam log information in the daily report.

3.4. Nondestructive Seam Quality Control Continuity Testing

As required by the Geomembrane Specifications, the QC Inspector will be required to nondestructively test all field seams as the seaming work progresses. The CQA Engineer shall verify that seams which fail are repaired in accordance with the Geomembrane Specifications. The CQA Engineer shall observe continuity testing and perform the following:

- Record location, date, test unit number, name of tester, and outcome of all testing;
- Mark on the geomembrane that the repair of failed seams have been made; and
- Document the results.

3.5. Destructive Seam Quality Control Testing

The CQA Engineer verify that the Installer obtains destructive QC samples of field seams and performs quality control testing in accordance with the Geomembrane Specifications. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

3.5.1. Location and Frequency

The CQA Engineer will coordinate with Contracting Officer to select locations where seam samples will be cut out for QC laboratory testing. The Installer shall not be informed in advance of the locations where the seam samples will be taken. Frequency and locations will be established in accordance with the Geomembrane Specifications.

3.5.1.1. Sampling Procedure

The CQA Engineer shall verify that the Installer obtains, numbers, and tests seam samples and logs the results in accordance with the Geomembrane Specifications.

3.5.1.2. Quality Control Field Testing

The CQA Engineer shall be present during all QC field testing and verify that the Installer and QC Inspector cut and test QC samples in accordance with the Geomembrane Specifications.

3.5.1.3. Geosynthetic Quality Control Laboratory Testing

The CQA Engineer shall verify that the QC Inspector obtains the appropriate QC seam samples and has them tested by the QC Laboratory as specified in the Geomembrane Specifications.

The QC Inspector will provide test results to the CQA Engineer in a timely manner. The CQA Engineer will review laboratory seam strength test results as soon as they become available, and inform the Contracting Officer of the test results.

3.6. Defects and Repairs

3.6.1. Identification

The CQA Engineer shall visually inspect all seams and non-seam areas of the geomembrane for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The CQA Engineer shall request that the geomembrane surface is broomed or washed by the Installer if the amount of dust or mud inhibits examination.

3.6.2. Quality Control Evaluation

The CQA Engineer shall visually inspect and verify that each suspect location both in seam and non-seam areas is non-destructively tested using the methods described for Quality Control testing in the Geomembrane Specifications and that each location which fails the non-destructive QC testing is marked by the QC Inspector and is repaired by the Installer. Materials should not be placed over geomembrane locations that have been repaired until the CQA Engineer has approved the repair.

3.6.3. Large Wrinkles

Prior to placing overlying materials, the CQA Engineer shall visually inspect the geomembrane for wrinkles and will indicate to the Installer which wrinkles, if any, shall be cut and resealed. The CQA Engineer shall ensure that the seam thus produced is tested like any other seam.

3.6.4. Repair Procedures

The CQA Engineer shall verify that any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test is repaired by the Installer in accordance with the applicable method specified in the Geomembrane Specifications.

3.6.5. Testing of Repairs

The CQA Engineer shall verify that seams that fail destructive seam testing are repaired in accordance with the Geomembrane Specifications.

3.7. Appurtenances

The CQA Engineer shall verify that:

- Installation of the geomembrane around, and connection of geomembrane to appurtenances have been made according to the Geomembrane Specifications;
- Extreme care is taken while seaming around appurtenances since neither non-destructive or destructive testing may be feasible in these areas; and
- The geomembrane has not been visibly damaged while being connected to appurtenances.

4. AS-BUILT DRAWINGS

The CQA Engineer shall verify that the QC Inspector prepares and submits as-built record drawings prior to proceeding with the overlying geosynthetics. The as-built record drawings shall include panel and seam identification codes, the location of field panels, date of installation, seam locations (both factory and field), and repair and test locations. The CQA Engineer shall review as-built drawings and compare them with contract drawings to ensure compliance with the requirements of the contract.

SECTION VI

GEOCOMPOSITE CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of geocomposite drainage layer (geocomposite) and outlines CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The function of the CQA Engineer is to verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the Project. The CQA Engineer shall also perform supplemental QA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02273: Geocomposite are reflected in this section of the CQA plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer or Authorized Representative shall be on site at all times during construction of the Geocomposite. All CQA individuals representing the CQA Engineer and assigned responsibilities for the QA for the work required by this section shall be familiar with the construction of geosynthetics and shall also be familiar with the test methods required in the project specifications.

2. GEOCOMPOSITE

2.1. Manufacturing

The geocomposite consists of geonet and geotextile materials manufactured into a geocomposite. The CQA Engineer shall verify that the Geonet was sampled and tested in accordance with the manufacturer's approved quality control manual and that test results not meeting the requirements specified in the Geocomposite Specifications result in the rejection of applicable rolls. The CQA Engineer shall review the following information from the geocomposite Manufacturer:

- Manufacturer's certified data sheets for bond adhesion;
- Manufacturer's quality control manual; and
- Manufacturer's certified raw and roll geocomposite and geonet material test results.

The CQA Engineer shall examine all geocomposite Manufacturer's certifications, QC manuals, and test results to verify compliance with the Geocomposite Specification.

2.2. Labeling

Upon delivery of the geocomposite, the CQA Engineer shall examine the geocomposite rolls and verify that each roll of geocomposite is labeled with the Manufacturer's name, product identification, lot number, roll number, and roll dimension. The CQA Engineer shall record the roll number and date each roll was delivered.

2.3. Delivery, Unloading, and Storage

Upon delivery of the geocomposite, the CQA Engineer, the geocomposite Installer, and the QC Inspector shall verify the following:

- Geocomposite rolls are not stacked more than two rolls high;
- Geocomposite material has been packaged, delivered, unloaded, and stored so that no damage to the geocomposite has or will occur;
- Geocomposite is free of dirt, dust, mud, or any other foreign material; and
- Damaged rolls are repaired or replaced by the Installer.

The CQA Engineer will inventory the delivered geocomposite and shall report to the Contracting Officer about any rolls or portions thereof that should be rejected and removed from the site, and any roll with minor flaws that are repairable.

2.4. Quality Assurance Conformance Testing

Upon delivery of the geocomposite rolls, the CQA Engineer shall collect samples at a rate of one per lot or one per every 400,000 SF of geocomposite to be placed. One out of every four samples shall be randomly selected by the CQA Engineer and forwarded to the QA Laboratory for testing to verify conformance with the Geocomposite Specification. The other samples shall be retained for possible additional testing.

QA conformance samples shall be taken across the entire width of the roll and will not include the outer wrap of the geocomposite roll. Samples shall be 1.5 feet long (minimum) by the roll width with the machine direction marked on the sample by the CQA Engineer. The CQA Engineer shall also write on the sample and affix a label to the sample with the following information:

- Sample number;
- Lot/batch number;
- Roll number;
- Date sampled;
- Project name;
- Manufacturer; and
- CQA Engineer's name.

QA conformance samples shall be tested for:

- Transmissivity (ASTM D 4716).

The CQA Engineer shall examine all results of QA Laboratory conformance testing and verify that the test results are in compliance with the specifications.

3. EXECUTION

3.1. Handling and Placement

The CQA Engineer shall visually inspect and verify that the geosynthetics Installer handles all geocomposite in such a manner as to ensure the geocomposite is not damaged in any way. The CQA Engineer shall periodically observe the installation and verify compliance with the following:

- The geocomposite is free of dirt or excessive dust just before installation;
- Just prior to geocomposite placement, the geomembrane liner that will underlie the geocomposite is clean and free of excessive amounts of soil, or other materials that could potentially damage or clog the geocomposite;
- The Installer deploys the geocomposite ensuring that the geocomposite and underlying material are not damaged;
- The Contractor and/or Installer is not allowed to drag geocomposite across a textured geomembrane during placement;
- Faulty or damaged geocomposite is replaced or repaired as specified in the Geocomposite Drainage Material Specifications;
- That the geocomposite is unrolled downslope keeping the geocomposite in slight tension to minimize wrinkles and folds and that the geocomposite is free of dirt, mud, or other foreign materials at all times during construction. Rolls which are contaminated with these materials are cleaned or replaced;
- Geocomposite is cut using scissors, hooked blade, or other cutting tools approved by the CQA Engineer that will not damage the underlying geosynthetics;
- Exposed Geocomposite core (i.e., geonets) are covered with overlapping geocomposite material or geotextiles meeting the geocomposite requirements;
- That adequate loading (e.g. sandbags) are placed to prevent uplift by wind; and
- Geocomposite is not welded to geomembrane.

3.2. Seaming Procedures

At a minimum, the CQA Engineer shall ensure that the following requirements are met:

- Adjacent geocomposite are overlapped so that the geonet overlaps by at least 4 inches and geotextile overlaps by at least 3 inches;
- The geonet overlaps are tied with plastic, non metallic fasteners and that tying devices are white or yellow for easy inspection;
- In the corners of the side slopes where overlaps between perpendicular strips are required, an extra layer is unrolled along the slope, on top of the previously installed geocomposite, from top to bottom of the slope;

- In the corners of the side slopes where overlaps between perpendicular strips are required, an extra layer is unrolled along the slope, on top of the previously installed geocomposite, from top to bottom of the slope; and
- When more than one layer of geocomposite is installed, joints are staggered;

3.3. Corners

The CQA Engineer shall visually inspect and verify that in the corners of side slopes, where overlaps between rolls of geocomposite are staggered, an extra layer of geonet is installed from the top to the bottom of the slope.

3.4. Repairs

The CQA Engineer shall visually inspect and verify that holes or tears in the geocomposite are repaired in accordance with the Geocomposite Drainage Material Specification.

The final decision as to the appropriate repair shall be agreed upon between the CQA Engineer and the Contracting Officer. Prior to acceptance of the geocomposite, the Installer shall locate and repair all damaged areas as directed by the CQA Engineer. Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile. The CQA Engineer shall observe any repair and report any noncompliance with the following requirements in writing to the Contracting Officer.

If in the CQA's judgement, the defect is determined to be small, typically smaller than 3 by 3 feet, the geocomposite shall be repaired as follows:

- If the geonet is judged to be undamaged but the geotextile is damaged, a patch of geotextile shall be placed;
- If the geonet is judged to be damaged, the damaged geonet shall be removed. A section of geonet shall be cut to replace the removed section. The geonet shall be tied to the existing geonet using white or yellow plastic fasteners placed at least every 6 inches overlap. A geotextile patch shall be placed over the repaired geonet section. The geotextile patch shall be thermally bonded in place with a minimum of 12 inch overlap in all directions; and
- Should any tear exceed 10% of the width of the roll, that roll shall be removed and replaced.

If, in the CQA's judgement, the defect is determined to be large, typically larger than 3 by 3 feet, the geocomposite shall be replaced.

3.5. Penetrations

The CQA Engineer shall visually inspect and verify that geocomposite penetration details are as recommended by the geocomposite manufacturer and as approved by the Contracting Officer by reviewing submittal information.

4.0 COVERING

The CQA Engineer shall visually inspect and verify that all geocomposite deficiencies are repaired prior to covering and that overlying material is not deployed such that tensile stress is mobilized in or damage occurs to the geocomposite. The CQA Engineer shall verify that the geocomposite is covered with the required materials within 14 days of acceptance in accordance with the Geocomposite Drainage Material Specification.

SECTION VII

SELECT FILL AND TOPSOIL CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the select fill and topsoil layer components of the cover system and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental QA conformance testing and visual inspections, and measurements for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02223: Select Fill and Topsoil for Landfill Cover are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer shall be on site at all times during construction of the select fill and topsoil layers. All CQA individuals assigned responsibilities for the select fill and topsoil layers shall be familiar with earthwork and shall also be familiar with the test methods required in the project specifications.

1.2. Submittals

A CQA Engineer shall review each submittal to ensure it complies with the specified requirements. Submittals requiring review include the following:

- Borrow source test results;
- Chemical Quality Tests; and
- As-Built Surveys.

2. SELECT FILL LAYER

2.1. Equipment

All equipment proposed for use during the construction of the select fill layer shall be inspected by the CQA Engineer to ensure compliance with the project specifications.

- Verify that the placement and compaction equipment are suitable for their intended purpose and will not damage underlying geosynthetic materials;
- Do not allow compaction equipment to operate at excessive speeds;
- Verify that the equipment proposed for use does not exceed the ground pressure requirements specified; and
- Inspect for sharp turns or sudden braking when construction equipment is operating above geosynthetic layers.

2.2. Quality Assurance Conformance Testing Requirements

The CQA Engineer shall be responsible for collecting QA soil samples and sending them to the QA laboratory for testing. Each sample shall be numbered and dated. The location and purpose of the samples shall be noted in the daily log. The following table lists the CQA tests which shall be performed on the clay layers during construction.

Test Type	Test Method	Frequency of Testing
USCS Classification	ASTM D 2487	20,000 CY
Particle Size	ASTM D 422	20,000 CY
Atterberg Limits	ASTM D 4318	20,000 CY
Initial Loose Lift Thickness	None	1 time per 10 loads
Loose Lift Thickness	None	3 times per 8 hour shift

The CQA Engineer shall verify that the above QA conformance tests are in compliance with the requirements of the specification.

2.3. Execution

- A CQA Engineer shall be present at all times during placement of the initial lift of cover soil over the geosynthetics;
- If multiple borrow sources are used for the soils, ensure that the soils from each borrow source meet the project specifications and that no deleterious objects which may damage the underlying cover system geosynthetic materials;
- Verify that no equipment is pulled or driven directly on geosynthetics which underlie select fill layer;
- Verify that the initial lift of select fill is placed at the thickness specified. A CQA Engineer shall physically measure the first loose lift thickness a minimum of 1 time per 10 loads of soil placed on site. The measurements shall be taken at random locations;
- Verify that subsequent loose lifts lie within the range specified. A CQA Engineer shall physically measure the loose lift thickness a minimum of 3 times per 8 hour shift at random locations;

3. TOPSOIL LAYER

3.1. Equipment

All equipment proposed for use during the construction of the select fill layer shall be inspected by the CQA Engineer to ensure compliance with the project specifications.

- Verify that the placement and compaction equipment are suitable for their intended purpose and will not damage underlying geosynthetic materials;
- Do not allow compaction equipment to operate at excessive speeds;

- Soil tests including pH, particle size, chemical analysis, mechanical analysis, and phosphorous and micro-nutrient levels.
- Verify that the equipment proposed for use does not exceed the ground pressure requirements specified; and
- Inspect for sharp turns or sudden braking when construction equipment is operating above geosynthetic layers.

3.2. Application of Soil Amendments

Verify pH, chemical analysis and mechanical analysis tests are performed to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of grass specified.

3.3. Fertilizer and Organic Matter Application Rates

The CQA Engineer shall verify the following by visual inspection and by review of QC tests:

- Fertilizer and organic matter are applied at the rates determined by the Contractor's soil test; and
- Fertilizer and organic matter is incorporated into the soil cover as it is constructed or is incorporated as part of the tillage operation.

3.4. Quality Assurance Conformance Testing Requirements

The CQA Engineer shall be responsible for collecting QA soil samples and sending them to the QA laboratory for testing. Each sample shall be numbered and dated. The location and purpose of the samples shall be noted in the daily log. The following table lists the CQA tests which shall be performed on the clay layers during construction.

Test Type	Test Method	Frequency of Testing
USCS Classification	ASTM D 2487	20,000 CY
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Initial Loose Lift Thickness	None	1 time per 10 loads
Loose Lift Thickness	None	3 times per 8 hour shift

The CQA Engineer shall verify that the above QA conformance tests are in compliance with the requirements of the specification.

3.5. Execution

- A CQA Engineer shall be present at all times during placement of the initial lift of cover soil over the geosynthetics;
- If multiple borrow sources are used for the soils, ensure that the soils from each borrow source meet the project specifications and that no deleterious objects which may damage the underlying cover system geosynthetic materials;

- Verify that no equipment is pulled or driven directly on geosynthetics which underlie select fill layer;
- Verify that the initial lift of select fill is placed at the thickness specified. A CQA Engineer shall physically measure the first loose lift thickness a minimum of 1 time per 10 loads of soil placed on site. The measurements shall be taken at random locations;
- Verify that subsequent loose lifts lie within the range specified. A CQA Engineer shall physically measure the loose lift thickness a minimum of 3 times per 8 hour shift at random locations;
- Verify that the final grade of the Topsoil Layer is placed to the lines and grade required by the contract documents by comparing the contract drawings with the as-built drawings.

SECTION VIII

TURF

CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of vegetative cover and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification section 02935: Turf are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of 1 CQA Engineer or Authorized Representative shall be on site at all times during placement of the vegetative cover. The CQA Engineer will perform periodic observations of all operations of the vegetative cover placement. All CQA individuals representing the CQA Engineer and assigned responsibilities for this section of work shall be familiar with all aspects of seeding and erosion protection and shall also be familiar with the test methods required in the project specifications.

2. VEGETATIVE SPECIES MANUFACTURE AND DELIVERY

2.1. Submittals

Prior to the placement of the vegetative species, the CQA Engineer shall review the following:

- Manufacturer's literature discussing physical characteristics, application and installation instructions of erosion control material;
- A list of equipment to be used and calibration test for seed application;
- The delivery schedule for vegetative species materials;
- Pesticide treatment plan, as specified;
- A written calendar time period for the turf establishment period. When there is more than one turf establishment period, the boundaries of the turfed area covered for each period is to be described;
- Certificates of compliance and test reports indicating that seed, fertilizer, and pesticides meet the requirements of the specifications; and

The CQA Engineer shall review the above information and verify that the above literature, lists, schedules, plans, records, calendars, certificates of compliance, and test data are in compliance with the contract documents.

The CQA Engineer shall, also review the written record of all maintenance work performed during the turf establishment period and verify that the maintenance meets the contract requirements;

2.2. Delivery, Handling and Storage

The CQA Engineer shall be present during the delivery and unloading of the seed and fertilizer and shall conduct a visual inspection for defects and damage. The CQA Engineer shall verify that seed classification, seed mixtures, seed quality, seed mixing procedure, seed formulas, soil amendments, fertilizers, topsoil, mulch, water, pesticides, and erosion control material meet the requirements of the specifications. Unacceptable materials shall be removed from the project site. The CQA Engineer shall also verify the following:

- Materials are stored in areas designated by the Contracting Officer;
- Seed and Fertilizer is stored in cool, dry locations away from contaminants and that pesticides are not stored with other landscape materials;
- Unacceptable materials are removed from the job site;
- Except for bulk deliveries, materials are not dropped or dumped from vehicles;
- Soil amendments are delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis and percent composition. In lieu of containers, soil amendments may be furnished in bulk;
- Pesticide material is delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses; and
- State Approved seed is provided in original sealed packages marked as specified.

2.3. Quality Assurance Conformance Testing Requirements

Unless determined necessary by the CQA Engineer, no QA tests are necessary for the vegetative species. The CQA Engineer shall, however, review the QC test reports and verify that the vegetative species meets the specifications.

3. VEGETATIVE SPECIES APPLICATION

3.1. Timing

The CQA Engineer shall verify the following:

- For spring planting, native grass seeding is sown from April 1 to June 15 and for fall planting from August 1 to September 15.
- If grass seed cannot be planted between the dates of April 1 to June 15, then a cover crop is planted to stabilize soils until the following seeding dates. Seed Foxtail Millet from May 1 to August 15, Annual Rye from February 16 to April 30, and Winter Rye from November 1 to February 15.
- Vegetative operations are performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work is stopped

when directed. When special conditions warrant a variance to the operations, proposed times are submitted to and approved by the Contracting Officer.

3.2. Site Preparation

The CQA Engineer shall visually inspect and verify that finished grades are as indicated on the drawings, and the placing of topsoil and smooth grading have been completed and that any deviations therefrom are corrected prior to seeding. Soil used for repair of erosion and correction of grade deficiencies must conform to the specifications. The CQA Engineer shall verify if additional topsoil is required beyond that available from grading operations, that it meets the contract specifications.

3.3. Tillage

The CQA Engineer shall visually inspect, measure as applicable, and verify the following:

- Soil on slopes gentler than 3 horizontal to 1 vertical (3H:1V) are tilled to a minimum depth of 6 inches;
- On slopes between 3 horizontal to 1 vertical and 1 horizontal to 1 vertical, the soil is tilled to a minimum depth of 2 inches by scarifying with heavy rakes, rotating chains drawn by tractor from the top of the slope, or rototiller when soil conditions and length of slope permit; and
- On slopes 1 horizontal to 1 vertical and steeper, no tillage is required.

3.4. Soil Compaction

The CQA Engineer shall visually inspect and verify that any compaction of the topsoil layer that occurs during construction activities of the soil cover (top 6") is repaired by scarifying, disking or plowing prior to seeding.

3.5. Finished Grading

The CQA Engineer shall visually inspect and verify the following:

- Turf areas are filled as needed or have surplus soil removed to attain the finished grade;
- Drainage patterns are maintained as indicated on drawings; and
- Turf areas compacted by construction operations are completely broken up by tillage.

3.6. Protection

The CQA Engineer shall visually inspect and verify that finished graded areas are protected from damage by vehicular or pedestrian traffic and erosion.

3.7. Application of Soil Amendments

Verify pH, chemical analysis and mechanical analysis tests are performed to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of grass specified.

3.8. Fertilizer and Organic Matter Application Rates

The CQA Engineer shall verify the following by visual inspection and by review of QC tests:

- Fertilizer and organic matter are applied at the rates determined by the Contractor's soil test; and
- Fertilizer and organic matter is incorporated into the soil cover as it is constructed or is incorporated as part of the tillage operation.

4. SEEDING

The CQA Engineer shall verify that prior to seeding, any previously prepared seedbed areas compacted or damaged by rain, traffic or other cause, is reworked to restore the ground condition previously specified and that seeding operations do not take place when the wind velocity will prevent uniform seed distribution. The CQA Engineer shall verify that seed varieties and quantities specified are uniformly distributed over all ground areas disturbed by grading and/or trenching in such manner that will produce an even stand of grass over the entire area seeded, as shown on the plans and as specified.

4.1. Equipment

The CQA Engineer shall visually inspect and verify that the equipment used and the methods of seeding are approved by the Contracting Officer prior to commencement of seeding operations and that immediately prior to the commencement of seeding operations, the Contractor has conducted seeding equipment calibration tests in the presence of the CQA Engineer. The CQA Engineer shall also verify the following:

- Seed is uniformly broadcast at the rates specified using broadcast seeders and that half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction;
- Seed is covered to an average depth of 1/4 inch but no more than 1/2 inch by disk harrow, steel mat drag, cultipacker, or other approved device;
- Seed is uniformly drop seeded to an average depth of 1/2 inch at the rate specified using a primary seeder, is done in two directions, 90 degrees in direction from the other, each direction at half the rate specified; and
- Row markers are used with the drop seeder.

4.2. Mulching

The CQA Engineer shall visually inspect and verify the following:

- Mulching is performed the same day as seeding and that mechanical anchoring of mulch is performed;
- Hay mulch is spread uniformly, in a continuous blanket, at the rate of 2 tons per acre;
- Mulch is spread by hand, blower-type mulch spreader or other approved method;
- Mulching is started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered and the mulch is not be bunched; and

- All seeded areas are mulched on the same day as the seeding.

4.3. Mechanical Anchoring

The CQA Engineer shall verify that immediately following spreading, the mulch is anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface a minimum of 3 inches, or other suitable equipment. .

4.4. Erosion Control Material

The CQA Engineer shall visually inspect and verify that the surface of ditches and slopes to receive soil erosion control material are finished to a smooth and even condition with all debris, roots, stones and lumps raked out and removed.

4.4.1. Erosion Control Blanket

The CQA Engineer shall verify the following:

- Soil erosion control blanket is unrolled on newly seeded areas;
- Wire staples are vertically applied through the blanket into the ground, keeping the blanket taut against the anchor staples;
- Erosion control blanket placement is accomplished without damage to the installed material or distortion of established grades; and
- Erosion control blanket is installed in accordance with the manufacturer's recommendations and where indicated on the drawings.

4.4.2. Erosion Control Fence

The CQA Engineer shall verify the following:

- Soil Erosion Control Fence is installed where indicated on the plans and in those areas required by the Contracting Officer for control of sheet or gully erosion;
- A six inch deep trench is dug just outside the posts for the full length of the silt fence;
- The studded "T" posts are set a maximum of 6 feet on center;
- The posts are inclined toward the runoff source at angle of not more than 20 degrees from vertical and are driven into the ground so that no more than 3 feet protrude above the ground;
- The fabric is attached to the posts, and placed into the trench and the soil is backfilled and compacted in accordance with the specifications;
- All splice joints are overlapped a minimum of 18 inches;
- Erosion control fence is installed in accordance with the manufacturer's recommendations and where indicated on the drawings; and

- "T" posts or other support structures do not penetrate the geosynthetic materials in the cover system.

4.5. Maintenance.

The CQA Engineer shall visually inspect and verify the following:

- The erosion control material is maintained until all work on the entire contract or designated portion thereof has been completed and accepted;
- Maintenance consists of the repair of eroded areas and the repair or replacement and restapling of loose or undermined erosion control material, including reseeding;
- The Contractor removes the silt on the uphill side of the silt fence whenever the silt is within 18 inches of the top of the fence and that the silt fence is removed at the completion of the project or when the vegetative layer is established such that no erosion occurs.;
- Silt is removed and disposed of as directed by the Contracting Officer and areas where silt has been removed are reseeded and remulched as specified.

4.6. Temporary Grass Cover

The CQA Engineer shall visually inspect and verify the following:

- When there are contract delays in the seeding operation or a quick cover is required to prevent erosion, the areas designated for turf is seeded with a temporary seed as directed by the Contracting Officer;
- Soil amendments are applied to the temporary cover as specified;
- The area is tilled in accordance with the specifications and seed is uniformly broadcast and applied at the rate specified; and
- The area is watered as required by the specifications.

4.7. Application of Pesticide

The CQA Engineer shall visually inspect and verify the following:

- When necessary to remove pests, weeds or disease, a state-certified applicator is used to apply pesticide in accordance with EPA label restrictions and recommendations;
- Hydraulic equipment is provided for the liquid application of a pesticide with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges; and
- A pesticide treatment plan has been submitted in accordance with the specifications.

4.8. Restoration and Clean Up

The CQA Engineer shall visually inspect and verify the following:

- Existing turf areas, pavements and facilities that have been damaged from the seeding operation are restored to original condition; and
- Excess and waste material is removed from the planting operation and is disposed of off the site and adjacent paved areas are cleaned.

4.9. Protection of Seeded Areas

The CQA Engineer shall verify that immediately after the seeding operations have been completed, the area is protected against traffic or other use by erecting barricades and providing signage as required or as directed by the Contracting Officer to provide protection against traffic and trespass.

4.10. Grass Establishment Period

The grass establishment period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end 60 days after the last day of turving operations required by this contract or until all work on this entire Contract has been completed and accepted, whichever period is longer. During the turf establishment period, the CQA Engineer shall verify that a satisfactory stand of turf for field seeded areas is established. A satisfactory stand of grass is defined as having a minimum of 100 grass plants per square foot. The total bare spots are not to exceed 5 percent of the total seeded area and weeds shall be less than 5% of the total plant growth.

4.10.1. Maintenance During Grass Establishment Period

The CQA Engineer shall verify that the maintenance of the seeded areas includes eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, and watering. The CQA Engineer shall verify the following:

- Field areas are mowed during the season to a minimum height of 6" whenever the plant growth exceeds 12" inches and as required to remove weedy plant species from the project as directed by the Contracting Officer;
- Treatment for disease or pest is in accordance with the specifications. Pesticide shall not be applied within 3 weeks of grass seed germination and shall meet all Federal, DOD and State guidelines; and
- The Contractor re-establishes as specified, eroded, damaged or barren areas. Mulch is also repaired or replaced as required.

4.10.2. Maintenance Report

The CQA Engineer shall verify that a written record is furnished to the Contracting Officer of the maintenance work performed.

SECTION IX

LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of the landfill gas collection system and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of specification sections 02252: Landfill Gas Extraction Well and Trenches, 02222: Excavation, Trenching, and Backfilling for Utility Systems, and 15370: Process Piping.

1.1. CQA Personnel

A minimum of 1 CQA Engineer shall be on site at all times while the landfill gas collection system is installed. All CQA individuals assigned responsibilities shall be familiar with standard piping installation practices and shall be familiar with the QC test methods required in the project.

2. MATERIALS

The CQA Engineer shall verify that all fittings, specials, joints, valves, flowmeters, miscellaneous fittings, and manholes are furnished in accordance with the contract requirements of specification.

2.1. Submittals

Prior to the installation of the force main and dual-containment piping, the CQA Engineer shall review and verify that the submittals meet the meet contract requirements.

2.2. Quality Assurance Conformance Testing

Unless determined necessary by the CQA Engineer, no QA conformance tests are necessary for project materials and equipment not specifically required by other sections of this document. The CQA Engineer shall, however, visually inspect all piping, valves, and joints and shall witness all QC tests, and shall review all QC test reports to verify that the system meets the specifications. The CQA Engineer shall verify that after piping systems have been tested by the QC Supervisor and put into service, but before final testing, adjusting, and balancing, that the QC Supervisor inspects each valve for possible leaks and for correct operation. The CQA Engineer shall verify that all valves and pipe are pressure tested in accordance with the specifications.

3. MATERIAL STORAGE, HANDLING, AND PLACEMENT

The CQA Engineer shall visually inspect and verify compliance with the following:

- Excavation, trenching, and backfilling is in accordance with the specifications.

- Pipe and accessories are handled so as to insure delivery to the trench in sound, undamaged condition and that pipe is carried into position and not dragged;
- The interior of the pipe and accessories is thoroughly cleaned of foreign matter before being lowered into the trench and is kept clean during the laying operations by plugging or other approved methods;
- Pipe damaged before installation or after laying is replaced with sound material;
- Pipe and fittings are handled and stored in accordance with the manufacturer's recommendations;
- Cutting of pipe is done with an approved type mechanical cutter in a neat and workmanlike manner without damage to the pipe;
- Pipe and accessories are carefully lowered into the trench and no materials are dropped or dumped into the trench;
- The full length of each section of pipe rests solidly upon the pipe bed and is not laid in water or when trench conditions are unsuitable for the work;
- Pipe that has the grade or joint disturbed after laying is taken up and relaid and when work is not in progress, open ends of pipe, fittings, and valves are securely plugged or capped so that no trench water, earth or other substance enters the pipe and fittings.
- Plastic pipe is installed in accordance with the specifications and is installed to drain to low points in the system;
- Pipe is clean inside before it is lowered into the trench and is kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves or other equipment;
- Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved;
- During the backfilling of the trench, foil backed magnetic tape is placed above the polyethylene pipe to permit locating with a magnetic detector;
- Jointing is in accordance with the specifications and the manufacturer's written instructions and the Installer's personnel demonstrate intimate knowledge of all installation procedures prior to start of installation;
- Valves are set plumb and are installed in accordance with Manufacturer's instructions and adequate support and anchoring is provided to prevent sagging and misalignment of piping;
- All holes for penetrations into manholes are drilled or cut in a workmanlike manner and pipe passing through plastic walls of manholes are sealed with inner and outer extrusion welded joints with four external gusset plates to provide a leak tight seal;
- Valves and flowmeters are set plumb and installed in accordance with manufacturer's instructions;

- Flowmeters are checked for proper operation;
- Before final testing, adjusting, and balancing, inspect each valve for possible leaks and for correct operation;
- Ensure that all parts and components are adjusted as required to provide correct operation;
- Gradation of granular filterpack meets requirements in specifications;
- Extraction well and trench are constructed with the materials and to the dimensions shown on the drawings or as indicated in the specifications;
- Extraction well and trench screen perforations are in accordance with the specifications; and
- Manholes of the types specified or indicated is constructed and installed in strict accordance with Manufacturer's instructions and that manhole pipe connections are made to the manhole in accordance with the manufacturer's recommendation.

SECTION X

MECHANICAL AND ELECTRICAL CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for the manufacturing and installation of all Mechanical and Electrical equipment and materials and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also monitor the materials used in and installation of all mechanical and electrical systems to assure compliance with Division 11, 13, 15, and 16 of the Technical Specifications and shall perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. The Contractor requirements of all Mechanical and Electrical specification sections are reflected in this section of the CQA Plan.

1.1. CQA Personnel

A minimum of one CQA Engineer shall be on site at all times while all mechanical and electrical materials and equipment are installed. All CQA Engineer individuals assigned responsibilities for the QA inspection of mechanical and electrical equipment and materials shall be familiar with mechanical and electrical material and equipment installation practices and shall be familiar with the QC test methods required in the contract.

2. MATERIALS

The CQA Engineer shall verify that all mechanical and electrical materials and equipment are in compliance with all contract requirements as detailed on the drawings and as specified in Division 11, 13, 15, and 16 mechanical and electrical specification sections. The mechanical and electrical systems include, but are not limited to, the following:

- Landfill Gas Treatment System.
- Overhead power distribution system, power wiring, including power circuit connections for blower and aftercooler motors, and equipment mounting boards.

2.1. Related Construction Drawings and Technical Specifications

The mechanical work performed by the Contractor shall comply with Construction Drawings and Divisions 11, 13, and 15 of the Technical Specifications. These specifications shall be referenced for specific details of the mechanical equipment requirements and installation. The electrical work performed by the Contractor shall comply with Construction Drawings and Technical Specifications. These specifications shall be referenced for specific details of the electrical requirements and installation.

2.2. Codes, Rules, Inspections, and Workmanship.

The CQA Engineer shall monitor the work of the Contractor in the installation of all mechanical and electrical appurtenances in accordance with national codes and other regulations or authorities having jurisdiction over the work. The CQA Engineer shall observe and document construction acceptance testing procedures performed by the Contractor. The CQA Engineer shall also observe and document all operational testing procedures performed by the Contractor.

2.3. Submittals.

Prior to the installation of mechanical and electrical materials and equipment, the CQA Engineer shall review all submittals and ensure compliance with the contract documents.

2.4. Quality Assurance Conformance Testing.

Unless determined necessary by the CQA Engineer, no QA conformance tests are necessary for project materials and equipment not specifically required by other sections of this document.

2.5. Record Drawings.

As the work progresses, the Contractor shall clearly and completely indicate any changes in layout and/or circuitry on a set of record drawings. The record drawings prints shall accurately show the actual mechanical and electrical installation work completed and indicate any variation with the Construction Drawings. The CQA Engineer shall monitor the Contractor's progress in maintaining the record drawings prints. The Contractor shall make the record drawings available for inspection by the CQA Engineer and the Contracting Officer at all times.

At the completion of work, the Contractor shall submit a set of record drawings through the CQA Engineer to the Contracting Officer. The CQA Engineer shall review the set of record drawings for accuracy and if necessary direct the Contractor to make corrections before forwarding the record drawings to the Contracting Officer.

3. MATERIAL STORAGE AND HANDLING

The CQA Engineer shall be present during the delivery and unloading of all mechanical and electrical material and equipment not specifically addressed in other sections of the CQA Plan and conduct a visual inspection for defects and damage. The CQA Engineer shall visually inspect and verify that material and equipment is stored such that no damage can occur to the materials and equipment and that any damage to material and equipment is repaired or the material and/or equipment is replaced. Conformance testing will be required for all project features not specifically addressed by other sections of the CQA Plan at the discretion of the Contracting Officer. If nonconformance or other deficiencies in the Contractor's materials or equipment or completed work are found by the CQA Engineer, the Contractor will be required to repair or replace at no cost. Any noncompliant items shall be reported to the Contracting Officer.

SECTION XI

GENERAL SITE WORK CONSTRUCTION QUALITY ASSURANCE

1. GENERAL

This section addresses the Construction Quality Assurance requirements for all work not specifically addressed in other sections of the CQA Plan including but not limited to CQA for the installation of culverts, chain link fence and gates, subdrain, landfill gas treatment facility structure, gabions, RCP, access roads, monitoring wells, landfill gas monitoring probes, and wetland vegetation planting and outlines the CQA responsibilities required to be performed by the CQA Engineer and/or Authorized Representatives. The CQA Engineer shall verify and document in the daily report that the Quality Control Inspector is performing all inspections and testing to assure Quality Control of the project. The CQA Engineer shall also perform supplemental CQA conformance testing and inspections for the purpose of Quality Assurance. In addition to documenting deviations and corrective actions in the daily report, the CQA Engineer shall also report any deviations directly to the Contracting Officer. No specific specification sections have been addressed in this section.

1.1. CQA Personnel

A minimum of 1 CQA Engineer shall be on site at all times while any work is being performed on the project. All CQA Engineer individuals assigned responsibilities for this work shall be familiar with all project installation practices and shall be familiar with the QC test methods required in the contract.

2. MATERIALS

The CQA Engineer shall verify that all materials are in compliance with the contract as detailed on the drawings and as specified in the contract documents.

2.1. Submittals

Prior to the installation of all project materials, the CQA Engineer shall review all of the applicable specified submittals to assure compliance with all contract requirements.

2.2. Quality Assurance Conformance Testing

Unless determined necessary by the CQA Engineer, no QA conformance tests are necessary for project materials not specifically required by other sections of this document. The CQA Engineer shall, however, visually inspect all materials are accordance with all contract requirements.

3. MATERIAL STORAGE AND HANDLING AND CONSTRUCTION

The CQA Engineer shall be present during the delivery and unloading of all materials not specifically addressed by other sections in the CQA Plan conduct a visual inspection for defects and damage. The CQA Engineer shall visually inspect and verify that materials are stored such that no damage can occur to the materials and that any damage to is repaired or the material is replaced. Conformance testing will not be required for project features not specifically addressed in other sections of the CQA Plan unless required by the Contracting Officer. If nonconformance or other deficiencies are found in the Contractors materials or completed work by the CQA

Engineer, the Contractor will be required to repair or replace at no cost. Any noncompliant items shall be reported to the Contracting Officer.

SECTION XII

CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

1. GENERAL

An effective CQA plan depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of construction quality assurance activities. The CQA Engineer and/or Authorized Representatives shall document that all quality assurance requirements have been addressed and satisfied.

2. DOCUMENTATION

The CQA Engineer shall document all construction activities and testing activities with Daily Record Keeping and Project Administration Records, Test Reports, Photographic Documentation, a summary of all design and/or specification changes, and a Final Report and shall provide the Contracting Officer with signed descriptive remarks, data sheets, and logs to verify and document that all monitoring activities have been carried out. The CQA Engineer will maintain at the site a complete file of Construction Drawings, the CQA plan, the General Specifications, test procedures, daily reports, testing logs, and other pertinent forms and documents. The forms to be used for CQA documentation should include, at a minimum, those presented in this CQA Plan in Appendix A. With the approval of the Contracting Officer, the forms presented in this CQA Plan may be revised as necessary by the CQA Engineer.

2.1. Daily Record Keeping and Project Administration Records

Daily records shall be completed in the field documenting CQA project administration, soils CQA, geosynthetics CQA, and other required CQA activities. The forms to be completed that pertain to each of these categories of records are discussed below. Most project administration records shall be completed daily and submitted weekly to the Contracting Officer. Examples of these forms are included in Appendix A and are briefly described below.

2.1.1. Daily Report

The Daily Report shall be prepared by the CQA Engineer and submitted weekly to the Contracting Officer. At a minimum, the Daily Field Report shall include the following information:

- The date, project name, location, and other identification;
- The weather conditions;
- A narrative of the events, activities, and construction activities underway, including meetings and observations which occurred during a given day;
- Equipment, personnel, and work at each construction component;
- Kinds and types of material used (what, where, when, and how often);
- QA and QC tests performed and test methods used;

- QA and QC test results, including corrective actions taken for all construction materials not meeting the specifications;
- Identify items requiring Contracting Officer's action;
- Corrective actions taken by the Contractor to repair any damage to underlying geosynthetics;
- The activities planned and performed;
- Discussions of geosynthetic placement such as precise areas placed, panel numbers, seams completed, test results, repairs and precise location and methods of repairs;
- Document borrow sources and placement activities for all soils;
- Lifts and locations of all soil placement activities completed;
- Visual inspection and visual observations noted on all construction activities, including any concerns noted;
- Visual changes in the borrow soils.
- A record of all visitors; and
- Record any important discussions, or conferences with the Contracting Officer, the Contractor, QC personnel, and Regulatory Agencies.

2.1.2. Daily Temperature Log

Daily ambient temperatures and liner temperatures taken in the morning and in the afternoon at the work area shall be recorded on the Daily Temperature Log by the CQA Engineer. This log shall be available for review at the site and shall be issued as part of the Final Report.

2.1.3. Personnel Daily Log

The Personnel Daily Log shall be prepared at the beginning of the project and updated each day by the Contractor and submitted to the CQA Engineer. The CQA Engineer shall also prepare a personnel log at the beginning of the project and update it daily. These logs shall list the Contractor's and CQA Engineer's personnel involved with the project and is a record of attendance for each day of the project. These logs shall be available for review at the site.

2.1.4. Contractor Personnel Log

Personnel Logs shall provide a summary of the Contractor's and CQA Engineer's personnel involved with the project (on site and off site), describe their position, and lists the time periods of involvement with site work. This log shall be available for review at the site.

2.1.5. Weekly Field Report

On a weekly basis, the CQA Engineer shall summarize in a Weekly Field Report the activities recorded on the Daily Field Reports. This shall be submitted each week to the Contracting Officer along with the daily Field Reports, and will include, at a minimum, the following information:

- The date, project name, and location;
- A summary of work activities during reporting period;
- A summary of construction situations, deficiencies, and/or defects occurring during the reporting period;
- A summary of actions taken to remedy such situations, deficiencies and/or defects;
- A summary of test results, failures and retests; and
- The signature of the CQA Engineer.

2.2. Test Reports

Test reports will be completed by the CQA Engineer and designated QA Inspection personnel. The purpose of the test reports are to summarize sampling result on an ongoing basis. The test reports will be collated and kept with the log book on a daily basis. The test reports will contain the following:

- A summary of field test results;
- A summary of the QC laboratory test results;
- Soils CQA Records;
- Geosynthetic CQA Records; and
- Pass/fail results with summaries to be submitted with periodic progress reports.

2.2.1. Soils CQA Records

Records kept for soils related activities will be completed by the CQA Engineer. Soils are defined as all soils utilized on the project. The information will be recorded as testing is done in the field or as results are received from the QA Laboratory. The records will be available for review on site, and copies will be issued as part of the Final Report. Examples of the relevant forms are included in Appendix A and are briefly described below. The results of field compaction tests will be recorded on Field Laboratory Compaction Test Logs (ASTM D 698 Method A, B, C, D and ASTM D 1557 Method A, B, C). Separate forms are available for each test method used.

2.2.1.1. Field Sand Cone and Rubber Balloon Density Test Log

The results of the sand cone and rubber balloon in-situ density test on soils will be recorded on the Field Sand Cone or Rubber Balloon Density Test Log. The results will be used for comparison or calibration with nuclear density test results.

2.2.1.2. Summary of Sieve Analysis Test Data

This form will provide a summary of sieve analysis test results for soils.

2.2.1.3. Summary of Field Density Test

This form will provide a summary of field nuclear density test results and sand cone test results for soils.

2.2.1.4. Summary of Index Laboratory Test Data

This form will provide a summary of index results performed as required for soils.

2.2.2. Geosynthetics CQA Records

Records for the installation of geosynthetics will be completed by the CQA Engineer. The information will be recorded as the work progresses. The records will be available for review on site and copies will be issued as part of the final CQA report. Typical required documentation is discussed below. Typical forms are provided in Appendix A.

2.2.2.1. Material Inventory

The identifying roll number and pertinent information of each roll of geosynthetics received at the site will be recorded on a form as the materials arrive at the site. This information will be used to track manufacturer's quality control information, conformance test samples, and other CQA documentation.

2.2.2.2. Nondestructive Test Log

A form will be used to record the time, date, equipment operator, and results of vacuum box or air pressure testing of production geomembrane seaming operations.

2.2.2.3. Panel Placement Monitoring Log

A form will be used to record geomembrane panel numbers as they are placed in the field and to cross-reference the assigned panel numbers with roll numbers. The weather conditions, time, and temperature at placement will be recorded on the log. Measured dimensions used to calculate the area of the geomembrane will be recorded on the log.

2.2.2.4. Repair Summary Log

Information on repairs to geomembrane panels and seams will be recorded on a form. The information recorded will include a code to describe the type of repair, the name of the operator making the repair, the location (i.e., seam or panel location) of the repair, nondestructive testing results of the repair, and initials of the CQA Engineer observing the repair.

2.2.2.5. Seam and Panel Repair Location Log

The relative location of repairs to geomembrane panels and seams described in the Repair Summary Log will be recorded on a form. The results of destructive tests and nondestructive tests can be indicated in this log, as well as, locations and results of thickness measurements taken for each panel.

2.2.2.6. Destructive Test Log

A form will be used to record the results from testing performed on geomembrane seams at the Geosynthetics CQA Laboratory (an independent testing laboratory). The results for both peel and shear will be recorded. The form will be completed as data becomes available.

2.2.2.7. Trial Seam and Seaming Log

A form will be used to record results of trial geomembrane seam testing and to track production seaming activities. The time, temperature, type of seaming equipment used, name of seamer, and length of seam will be recorded.

2.2.2.8. Certificate of Acceptance of Subgrade Surface

The Certificate of Acceptance is required to be signed each day geomembrane and GCL is placed. Each certificate will be signed by the Contractor and CQA Engineer prior to installation of the geosynthetics. The area being accepted must be described on the certificate.

2.3. Survey Records

Record Drawings resulting from the surveying performed by the surveyor will be reviewed by the CQA Engineer and the Contracting Officer. The Record Drawings will be available for review on-site, and copies will be issued as part of the Final CQA Report issued by the CQA Engineer. At a minimum these Record Drawings will include, but is not limited to, the survey data for the following cover system components:

LANDFILL COVER SYSTEM

- Top of Topsoil Layer;
- Piping Alignments; and
- Settlement Gages.

2.4. Photographic Documentation

Photographic documentation will serve as a pictorial record of work progress, problems, and mitigation activities. Monthly photographs, comprising of at least 24 exposures, will be taken of every phase of construction being performed at the time. Additional photographs will be taken, as needed to document potential contractual or regulatory problems. The basic file will contain color prints; negatives will also be stored in a separate file in chronological order. These photographs will be available for review by the Contracting Officer, the CQA Engineer, and other interested parties. Selected photographs will be reproduced as part of the Final Report. The remaining photographs will be transmitted to the Contracting Officer and archived by the Contracting Officer as part of the operating records.

2.5. Design and/or Specifications Changes

Design and/or specification changes may be required during construction. In such cases, the CQA Engineer will notify the Contracting Officer. The Contracting Officer will notify USEPA, and when necessary, the Design Engineer. Major design and/or specification changes will be made only with the written agreement of the Design Engineer and the Contracting Officer and will take the form of a modification to the General Specifications.

2.6. Final Report

At the completion of the work, the CQA Engineer will be responsible for writing a Final Report on CQA activities performed at the site. The Final Report will be completed and submitted to the Contracting Officer

no more than 28 days after the completion of construction and will include at a minimum, the following information:

- Brief description of the project including type of facility, name of site, location, altitude, name of Owner, Design Engineer, Contractor, geomembrane Installer, earthwork contractor, and any other major subcontractor;
- Detailed description of the cover system, including surface area, cross sections, definition of all materials, etc.;
- Reference to the CQAP;
- Copy of, or reference to, geosynthetic manufacturer's QC documentation;
- General record of activities, such as dates of performance of QA operations, number and names of QA Inspector's, number and names of geosynthetic Installer's personnel, etc.;
- Photographic Documentation, including photograph's of the site at different phases of construction, photograph's of construction details, and photographs of all QA operations;
- Copy of all forms and logs filled out by CQA Engineer and CQA Inspection Personnel and a copy of all Daily Reports;
- Copy of all QA field and laboratory test results;
- Discussion of special problems encountered and their solutions;
- Copies of the written acceptance of the subgrade by the geosynthetic Installers and CQA Engineer;
- As-Built survey records;
- Summaries of all construction activities;
- Observation logs and testing data sheets including sample location plans;
- Discussion of any changes from design and material specifications;
- CQA Record Drawings, which include the CQA Record Drawings containing the geomembrane panel layout drawings, all drawings including those cross-sections depicting any deviations from the Construction Drawings, and all survey conformance data; and
- A summary statement sealed and signed by the CQA Engineer, who will be a Professional Engineer registered in the State of Indiana that construction quality assurance was conducted as provided in the CQA Plan and, based on visual observations and data generated in accordance with the CQA Plan, the cover system was constructed in accordance with the Construction Drawings, the CQA Plan, and the General Specifications, except as properly authorized and documented in the CQA Final Report.

APPENDIX A

FIELD INSPECTION FORMS

**Field Density Test
Sand Cone Method (ASTM D-1556)**

Time Started Project _____
Time Arrived at Site _____
Time Left Site _____
Time Tests Completed _____

Job No. _____ Technician _____

Test No.									
Date									
A. Initial Weight Jar and Sand - lbs.									
B. Weight Jar and Sand Retained - lbs.									
C. Weight Sand Used - lbs. (A-B)									
D. Weight Sand in Cone and Plate - lbs.									
E. Weight Sand in Hole - lbs. (C-D)									
F. Unit Weight of Sand - lbs.									
G. Volume Hole - lbs./ft ³ (E/F)									
H. Weight Soil and Container - lbs.									
I. Weight Container - lbs.									
J. Weight Soil - lbs. (H-I)									
K. Wet Density of Soil - lbs./ft ³ (J/G)									
L. Wet Weight Moisture Sample - grams									
M. Dry Weight Moisture Sample - grams									
N. Weight Water - grams (L-M)									
O. Moisture Content - % ((N-M)/M)x100									
P. Dry Density of Soil - lbs./ft ³ (K/(1+O))									
One Point Procter Determination									
Q. Weight Sample and Mold - lbs.									
R. Weight Mold - lbs.									
S. Mold Volume Factor									
T. Wet Density Compacted Sample - lbs./ft ³ ((Q-R)/S)									
U. Wet Weight Moisture Sample - grams									
V. Dry Weight Moisture Sample - grams									
W. Weight Water - grams (U-V)									
X. Moisture Content Compacted Sample - % ((W/V)/V)x100									
Y. Dry Density Compacted Sample - lbs./ft ³ (T/(1+X))									
Z. Maximum Dry Density - lbs./ft ³									
AA. Optimum Moisture Content - %									
BB. Compaction Results - % ((P/Z)x100)									
Test Location (From a Permanent Reference Point)									
Test Elevation or Depth of Fill - ft.									
Lab Curve Number									
Evaluation (Pass or Fail)									

**Compacted Soil Liner
Field Density Tests**

Project No. _____
CQA eng. _____

Date _____
Contractor _____

Construction Activities: Today the Contractor placed fill at the following locations: _____

Test Conducted and Results: _____ () field density tests were performed. The test results are as follows:

Test Number	Percent Compaction	Location	Depth	Pass/Fail

Non-Compliance Test Results: Name of Contractor's/Contracting Officer's Representative Informed: _____

Other Discussions with Contractor/Contracting Officer: _____

THE FOLLOWING TEST(S) PERFORMED TODAY WILL REQUIRE SUBSEQUENT TESTING:

CQA eng. Signature: _____

SUBGRADE CERTIFICATION

Project Name _____
Project No. _____
Weather _____

Date _____
Inspector _____

Panels: _____

The subgrade surface upon which the above liner panels have been placed was approved for the placement of the geomembrane immediately prior to installation:

YES _____ NO _____

If "NO", state reason for disapproval. _____

Recommended corrective action. _____

Was corrective action taken?

YES _____ NO _____

Date: _____

Installation Superintendent

CQA Inspector

Date Installed

**RECEIVING INSPECTION
GEOMEMBRANE**

Project Name _____
 Project Number _____
 Transporter/Supplier _____
 Number of Rolls Delivered _____
 Storage Location _____

Date _____
 Received by _____
 Inspected by _____
 Delivery Invoice No. _____

Manufacturer's Designation _____

Manufacturer's Batch No. _____

Material Width/Length/Thickness _____

(Provide explanatory notes if the answer to any of the following questions is "no". Include any remedial steps required/taken.)

	<u>YES</u>	<u>NO</u>	<u>NOTE NO.</u>
Check before unloading:			
• Is the material undamaged?	_____	_____	_____
• Is the material acceptable for use?	_____	_____	_____
Check after unloading:			
• Is the material still undamaged?*	_____	_____	_____
• Is the material properly stored?	_____	_____	_____

*If the answer is "no", note whether damage is severe enough to necessitate repair.

NOTES:

PANEL INSPECTION REPORT

Project Name: _____ Project No. _____ Installer: _____

[illegible]

CQA Inspector: _____

CQA SEAM INSPECTION FORM

Project Name _____
 Project No. _____
 Installer _____
 Welding Tech. _____
 Type of Welder _____
 Date Welded _____

Seam No. _____
 Seam Length _____
 Seam Location _____
 Welding Unit No. _____
 Time Welded _____ a.m., p.m.

Quality Control/Assurance Summary

1. Vacuum Box and/or Impact Testing

VB	IT	
		Date Tested
		QC Technicians Initials
		No. of Repairs Found
		Date Repairs Made
		Date Retested
		Date Inspected and Approved

2. Air Pressure Testing

Zone	Length (ft.)	Pressure Loss (psi)	Approved (Y/N)	If 'no' Corrective Action	CQA eng. Initials

3. Destructive Testing

Sample No.	All Specimens Approved (Y/N)	If 'no' Corrective Action	CQA eng. Initials

Seam Approval

Signature of CQA eng. _____

Date of Approval _____

SEAM LABORATORY DESTRUCTIVE TEST

Project Name _____ Installer _____
 Project No. _____ Date _____ Seam No. _____
 Weld Type: Extrusion _____ Fusion _____ Testing Location: Field _____ Laboratory _____

Fusion Weld Peel Test.

Specimen #	Width (in.)	Thickness (in.)	Yield Load (lb.)	Peel Strength (psi)	Peel Length (in.)	Elongation			Weld Crack (Y/N)	Observations	CQA eng. Approval (initial)
						Start	End	Change			
1	outer										
1	inner										
2	outer										
2	inner										
3	outer										
3	inner										
4	outer										
4	inner										
5	outer										
5	inner										

Extrusion Weld Peel Test.

Specimen #	Width (in.)	Thickness (in.)	Yield Load (lb.)	Peel Strength (psi)	Peel Length (in.)	Elongation			Weld Crack (Y/N)	Observations	CQA eng. Approval (initial)
						Start	End	Change			
1											
2											
3											
4											
5											

Shear Test.

Specimen #	Width (in.)	Thickness (in.)	Yield Load (lb.)	Shear Strength (psi)	Elongation			Weld Crack (Y/N)	Observations	CQA eng. Approval (initial)
					Start	End	Change			
1										
2										
3										
4										
5										

Approved: Yes _____ No _____ If No, corrective action taken: _____

Retest Corrective Action: Yes _____ No _____

Percent Change = [(end - start) x 100]/start

CQA eng. _____

**RECEIVING INSPECTION
GEOCOMPOSITE**

Project Name _____
Project Number _____
Transporter/Supplier _____
Number of Rolls Delivered _____
Storage Location _____

Date _____
Received by _____
Inspected by _____
Delivery Invoice No. _____

Manufacturer's Designation _____

Manufacturer's Batch No. _____

Material Width/Length/Thickness _____

(Provide explanatory notes if the answer to any of the following questions is "no". Include any remedial steps required/taken.)

	<u>YES</u>	<u>NO</u>	<u>NOTE NO.</u>
Check before unloading:			
• Is the material undamaged?	_____	_____	_____
• Is the material acceptable for use?	_____	_____	_____
Check after unloading:			
• Is the material still undamaged?*	_____	_____	_____
• Is the material properly stored?	_____	_____	_____

*If the answer is "no", note whether damage is severe enough to necessitate repair.

NOTES:

INSTALLERS DAILY REPORT

Project Name _____
Project No. _____
Weather _____

Date _____
Installer _____

Start Time: _____
Break Time: _____
Stop Time: _____

Installer Personnel:

Hours Worked:

Total Manhours _____

Tasks Performed and Manhours for Each Task (Complete Liner Installation Summary on Back):

_____ sq. ft. of liner installed;
_____ sq. ft. of geotextile installed;
_____ sq. ft. of geonet installed;
_____ sq. ft. of pipe installed;

_____ Manhours
_____ Manhours
_____ Manhours
_____ Manhours
_____ Manhours
_____ Manhours
_____ Manhours

Total Manhours _____

Workplan for tomorrow:

Discussions with CQA inspector/CO, problems encountered, and solutions.

Superintendent Signature _____

Date _____

CQA Inspector Signature _____

Date _____

CONTRACTORS DAILY REPORT

Project Name _____
Project No. _____
Weather _____

Date _____
Installer _____

Start Time: _____
Break Time: _____
Stop Time: _____

Installer Personnel:

Hours Worked:

Total Manhours _____

Tasks Performed and Manhours for Each Task (Complete Liner Installation Summary on Back):

Manhours
Manhours
Manhours
Manhours
Manhours
Manhours
Manhours
Manhours

Total Manhours _____

Workplan for tomorrow:

Discussions with CQA inspector/CO, problems encountered, and solutions.

Superintendent Signature _____

Date _____

CQA Inspector Signature _____

Date _____

CQA INSPECTORS DAILY REPORT

Project Name _____
Project No. _____
Weather _____

Date _____
Installer _____

Construction activities:

Tests conducted and results:

Non-compliance test results, name of contractor's/CO's representatives informed:

Other discussions, problems encountered, and solutions:

Workplan for tomorrow:

CQA Inspector Signature _____

Date _____

FINAL ACCEPTANCE REPORT

Project Name: _____ **Date** _____
Project No. _____

The Project has been inspected in accordance with the CQA plan and the project is certified to have been constructed in accordance with the requirements of the Contract documents, including the plans and specifications.

CQA Engineer Certification Signature:

Signed _____ **Date** _____